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AUTHOR Kim, Heeyoung; Chung, Ji-Sook; Kim, Younghoon

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ABSTRACT

The purpose of this paper is to discuss how general problem-based learning (PBL) models and social-constructivist perspectives are applied to the design and development of a Web-based science program, which emphasizes inquiry-based learning for fifth grade students. The paper also deals with the general features and learning process of a Web-based science program, including the teacher's action, the student's learning activity, and cognitive tools to scaffold the student's inquiry. A major goal of PBL in the Web-based science program is to help students develop scientific thinking and problem solving skills through a set of interaction tools (teacher-to-student, student-to-student, group-to-group, student-scientist, and student-cognitive). The main stages of PBL in the Web-based science program are: (1) "Your Challenge," in which students engage in an authentic problem situation; (2) "Plan Inquiry," in which students identify what they know, what they need to know to solve a problem, and how they go about finding out; (3) "Explore Resources," in which students gather information, learning primary concepts and principles necessary to solve the problem, and contact a scientist to acquire a scientific thinking process for solving problems and their perspective about the problem; (4) "Generate Alternative Solutions," in which students come up with alternative solutions to the problem after analyzing information and data; and (5) "Reflection and Presentation," which focuses on feedback from the teacher, students, and scientist about alternative solutions. After revising their solutions, students present their best solutions. In this learning cycle, scaffolding or cognitive tools support students' activities. (Author/AEF)

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Problem-Based Learning in Web-Based Science Classroom

Heeyoung Kim
Ji-Sook Chung
Younghoon Kim
The Pennsylvania State University

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Abstract

The purpose of this presentation is to discuss how general problem-based learning model and social-constructivist perspectives are applied to design and develop a web-based science program, which emphasizes inquiry-based learning environment for 5th grade students. The presentation also deals with general features and the learning process of web-based science program, including teacher's action, the student's learning activity, and cognitive tools to scaffold the student's inquiry. A major goal of PBL in web-based science program is to help students' construct scientific thinking and problem solving skills through a set of interaction including teacher-to-student, student to-student, group-to-group, student-scientist, and student-cognitive tools. The main stages of PBL in web-based science program as a learning cycle are 1) "Your Challenge" which students engage in an authentic problem situation, 2) "Plan Inquiry" which students identify what they know, what they need to know to solve a problem, and how they go about finding out, 3) "Explore Resources" which students gather information, learn primary concepts and principles necessary to solve the problem, and contact with scientist to acquire scientific thinking process for solving problem and their perspective about the problem, 4) "Generate Alternative Solutions" which students come up with alternative solutions to the problem after analyzing information and data, 5) "Reflection & Presentation" which focus on feedback from teacher, students, and scientist about alternative solutions. After revising their solutions, students present their best solutions. In this learning cycle, scaffolding or cognitive tools support students' activity to communicate scientific arguments and to solve the problem.

Why PBL?

Problem-Based Learning provides minds-on and hands-on experience for students to engage in real world problem (Torp & Sage, 1998). During the Problem-based Learning, students (1) play the role of stakeholders in the problem scenario, (2) engage in an ill-structured problematic situation, (3) identify what they know and need to know, (4) define the problem to focus further investigation, (5) gather and share information related to the problem situation, and (6) generate several possible solutions and identify the solution of best fit (Torp & Sage, 1998; Savery & Duffy, 1996; Albanese, A. M., & Mitchell, S., 1993).

Hewitt and Scardamalia (1996) addresses the why PBL works.

- Inquiry is focused upon communal problems of understanding where meaning is negotiated through questioning, theory refinement, and dialogue.
- Students' ideas about what they need to know become the focus of inquiry.
- Knowledge is shared and held collectively. New information that is shared has the potential of shaping subsequent investigations by others.
- The artifacts of student inquiry are made public and used in knowledge production. These include problem maps that integrate information and highlight connections, graphic organizers that help visualize patterns and relationships, and loop writing that provides opportunities for students to respond to the thinking of their peers.
- Responsibility for planning, organizing, questioning, and summarizing is shared among the students and facilitated by the teacher.

Problem-based learning helps students develop and practice ways to solve problems that are in some way relevant to issues they can relate to. By allowing students to work through problems, they develop reasoning skills and are able to think through real problems more critically. Students are generating their knowledge by themselves with experiences and prior knowledge.

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Providing teachers' space about how to coach will give teachers, who are using PBL in their teaching, idea how to scaffold and facilitate in PBL environments.

Why Web-Based?

In this learning environment, students should be provided feedback to responses made during the learning process. It may be necessary for teacher-to-student, student to-student, and group-to-group, to communicate in the same time frame and have coordinated access to the same World-Wide Web pages. In order to provide responsive feedback, web-based learning environment with interactive media (BBS or Email) is need (Dick & Carey, 1996).

This is designed for classroom study with computers connected with the Internet. Internet will give students have full of chance to search resources. Another reason for choosing web-based learning environment is for any teachers, who have the Internet connection in their classroom, and who want to use this learning environment.

The purpose of this learning environment is to discuss how general problem-based learning model and social-constructivist perspectives are applied to design and develop a web-based science program, (comma) which emphasizes inquiry-based learning environment for 5th grade students. This project also deals with general features and the learning process of web-based science program, including teacher's action, the student's learning activity, and cognitive tools to scaffold the student's inquiry.

A major goal of PBL in web-based science program is to help student construct scientific thinking and problem solving skills through a set of interaction including teacher-to-student, student to-student, group-to-group, student-scientist, and student-cognitive tools. In this learning environment, teachers are active coaches, and students are active students.

Learning Stages of PBL

PBL is an instructional method characterized by the use of "real world" problems [Figure, 1] "Problem" as a context for students to learn critical thinking and problem solving skills, and acquire knowledge of the essential concepts of the course. Using PBL, students acquire life long learning skills, which include the ability to find and use appropriate learning resources. These problems are used to engage students' curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources.

HOME
Center County, State College
Environmental Protection Research Group
Richard Land, Director
The Chesapeake Bay Program Office
M * E * M * O
Date: October 30, 2001
To: Environmental Protection Research Group
From: Richard Land
Subject: Environmental Protection
The Chesapeake Bay program office has monitored the quality of water because the water supports more than 3000 species of plants and animals that are living in the Chesapeake Bay areas. We recently found that the water was not healthy and several hundreds of fish died in the Chesapeake Bay. We believed that harmful materials ordered into and pollute the water, and eventually killed many of fish. Determine the cause of this outbreaks and recommend appropriate solutions. I will expect to hear from you on the afternoon of November 8, 2001. In the meantime, I will contact the state to obtain the necessary additional funds to implement the best solution.

Figure 4 Problem (Screenshot)

After meeting the real world problem scenario, students will be engaged in the five stages to solve the problem. The main stages of PBL in web-based science program for students are (1)

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"Your Challenge", (2) "Plan Inquiry", (3) "Explore Resources", (4) "Generate Alternative Solutions", and (5) "Reflection & Presentation

Your Challenge

Students engage in an authentic problem situation. In "Your challenge" stage, students assign the role based on problem scenario and situation by discussions and negotiations with other members of group [Figure 2]. Groups were made up of three to four students.

Figure 2 Your Challenge Stage (Screenshot)

Plan Inquiry

Students identify what they know, what they need to know to solve a problem, and how they go about finding out [Figure 3]. "I Know This" which students will have to prove what they know from meeting the problem

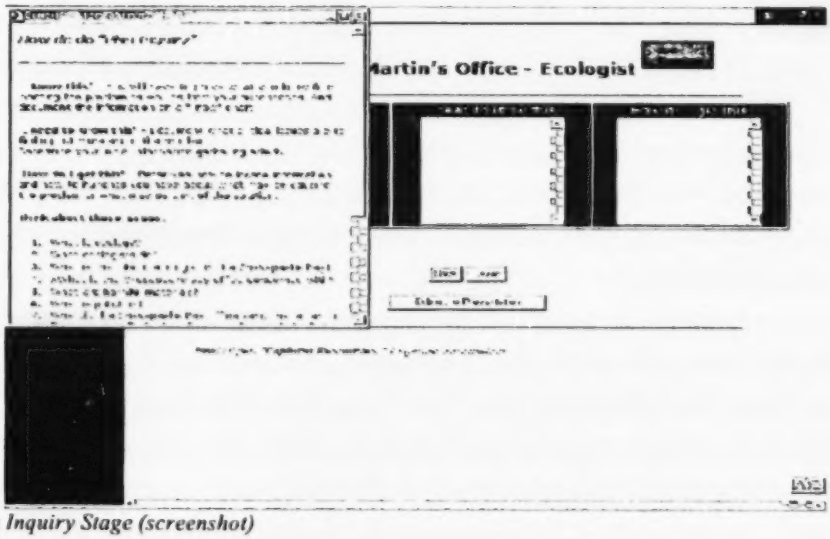

Figure 3 Plan Inquiry Stage (screenshot)

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as well as from their experiences, and document the information on a "Know" chart. "I need to know this", which document what critical issues are to finding out more about the problem. Determine students' initial information gathering effort. "How do I get this" which determine how to get information, and how to hunches students have about what may be causing the problem or what may be part of the solution. Under the guidance of a teacher, the students must take responsibility for their own learning, identifying what they need to know to better understand and manage the problem on which they are working and determining where they will get that information. This allows each student to personalize learning so as to concentrate on areas of limited knowledge or understanding, and to pursue areas of interest.

Explore Resources

Students gather information, learn primary concepts and principles necessary to solve the problem, and contact with scientist to acquire scientific thinking process for solving problem and their perspective about the problem. Resources will be different by student' role, for example, ecologist will have and gather information that appropriate and relate information to him/her, so that student will became an ecologist.

Generate Alternative Solutions

Students come up with alternative solutions to the problem after analyzing information and data, and recommend solutions based on the information students have gathered using the Decision-Making Matrix [Figure 4]. From the information students have gathered, students will have to come up good judgments supported by criteria, context, self-correction, and explicit reasons for drawing a conclusion, note the strategy, pros, cons, and consequences which are discussed with your group member in the box, and assign a score to each pro or con, from 1 (weak) to 5 (strong) using the Decision-Making Matrix for the their final solution.

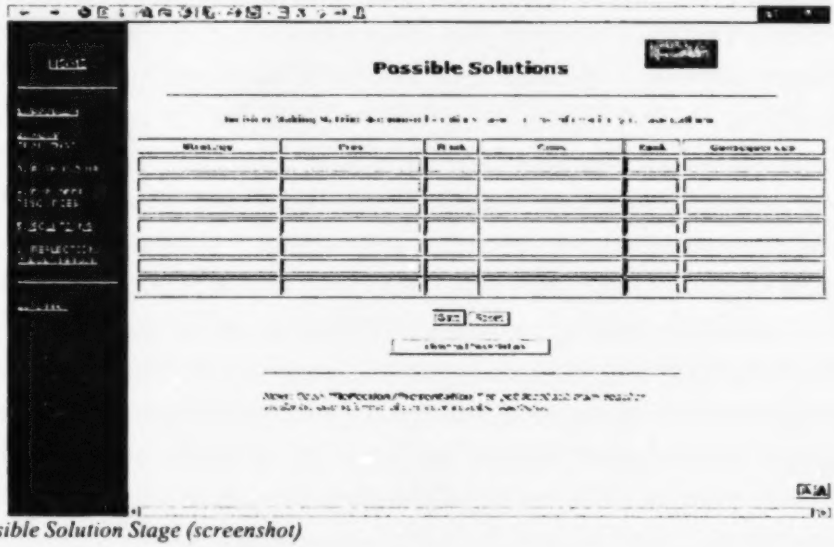

Figure 4 Possible Solution Stage (screenshot)

Reflection & Presentation

Focus on feedback from teacher, students, and scientist about alternative solutions [Figure 5]. After revising their solutions, students present their best solutions. After revising their solutions, students present their best solutions. When students finish each "Plan Inquiry", and "Solutions" they will show this stage. By clicking button, which is under "Plan Inquiry", and "Possible Solutions", each student can review other student's work. And send an e-mail to give feedback or comments.

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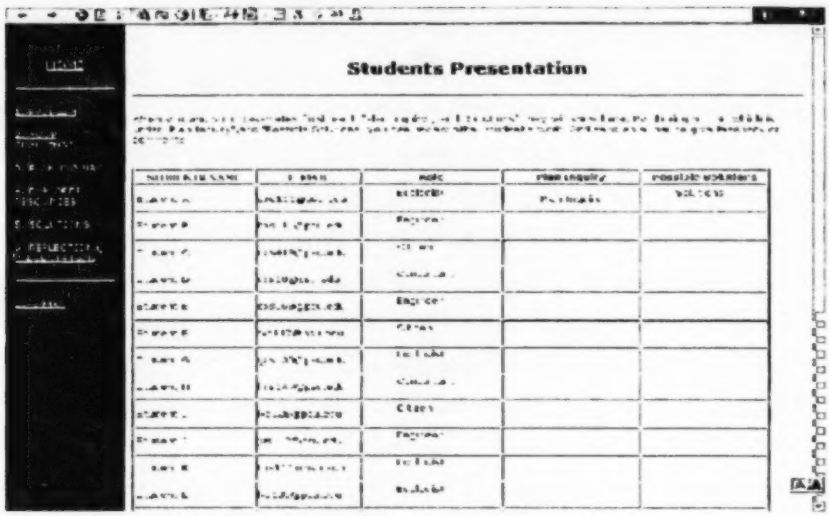

Figure 5 Reflection and Presentation Stage (screenshot)

Ask Teacher

In the stages of Plan Inquiry and Possible Solution, students will have "Ask Teacher" that works as a model for supporting students' work through the process of problem solving.

Teachers' guidelines

In each stages, teachers will have guidelines about "what is coaching" and "how and what do I coach?"[Figure 6]. The PBL teachers are facilitator or activators of the students' learning initiatives. Working to guide, motivate, and probe the students' reasoning process as they journey through the problems rather than to direct it is often a less comfortable role, and requires a blend of creativity, ingenuity, and flexibility in its implementation Designing problem-based learning in web-based environment is more beneficial to provide and

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Figure 6 Teachers' Guideline (screenshot)

support scaffolding. Most web-based instruction just ignores the teacher's role and interface. We can hardly capture the teacher's work place in the web-based learning. Teachers just give students feedback. However, teachers only guide students through the process of problem solving, and they provide no direct answers for the questions. Teachers using PBL face the difficult task of guiding without leading, assisting and directing. Teachers' work in PBL involves guiding students through the process of developing possible solutions, and determining the best solutions with the justification.

Teachers' role should be in form of questioning, cueing, prompting, coaching, modeling ideal performance, mentoring, telling or discussing. Teachers can maintain joint attention on a goal by adopting PBL process, using role and drama, managing group work, and monitoring student engagement.

If student provides an accurate but incomplete explanation, teachers are likely to provide a recast or expansion of the student's explanation. Teachers deliberately plan their presentation of problems to facilitate the asking of though-provoking questions that involve the comparison of different problems or problem-solving techniques.

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